## PROVINSIALE VOORBEREIDENDE EKSAMEN/ PROVINCIAL PREPARATORY EXAMINATION

## GRAAD/GRADE 12

## FISIESE WETENSKAPPE/PHYSICAL SCIENCES

## VRAESTEL/PAPER 1

## FISIKA/PHYSICS

## SEPTEMBER 2024

**PUNTE/MARKS: 150**

**TYD/TIME: 3 uur/hours**

**Hierdie vraestel bestaan uit 16 bladsye en 3 gegewensblaaie./
This question paper consists of 16 pages and 3 data sheets.**

Blaai om asseblief/Please turn over

September 2024

## INSTRUCTIONS AND INFORMATION

1. Write your name on the ANSWER BOOK.

2. This question paper consists of 10 questions. Answer ALL the questions in the ANSWER BOOK.

3. Start EACH question on a NEW page in the ANSWER BOOK.

4. Number the answers correctly according to the numbering system used in this question paper.

5. Leave ONE line between two subquestions, e.g. between QUESTION 2.1 and QUESTION 2.2.

6. You may use a non-programmable calculator.

7. You may use appropriate mathematical instruments.

8. Show ALL formulae and substitutions in ALL calculations.

9. Round off your FINAL numerical answers to a minimum of TWO decimal places.

10. Give brief motivations, discussions, etc. where required.

11. You are advised to use the attached DATA SHEETS.

12. Write neatly and legibly.

## QUESTION 1:  MULTIPLE-CHOICE QUESTIONS

Various options are provided as possible answers to the following questions. Each question has only ONE correct answer. Choose the answer and write only the letter (A–D) next to the question numbers (1.1 to 1.10) in the ANSWER BOOK, e.g. 1.11 E.

1.1     Which ONE of the following physical quantities is defined as the rate of change of velocity?

A       Impulse

B       Net force

C       Inertia

D       Acceleration                                                                                          (2)

1.2     According to Newton's Third Law of Motion, the reaction force to the weight of a book lying on a table is the …

A       normal force.

B       force of the book on Earth.

C       force of Earth on the book.

D       force of the book on the table.                                                          (2)

1.3     A 300 kg bag of cement and a 30 kg iron sphere are dropped simultaneously from the roof of a building. Ignore the effects of air friction.

When they are 9 m above the ground, they will have the same …

A       momentum.

B       acceleration.

C       kinetic energy.

D       potential energy.                                                                                (2)

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1.4 A ball of mass **m** strikes a wall perpendicularly at a speed **v**. After the collision, the ball moves in the opposite direction at the same speed **v**, as shown in the diagram below.
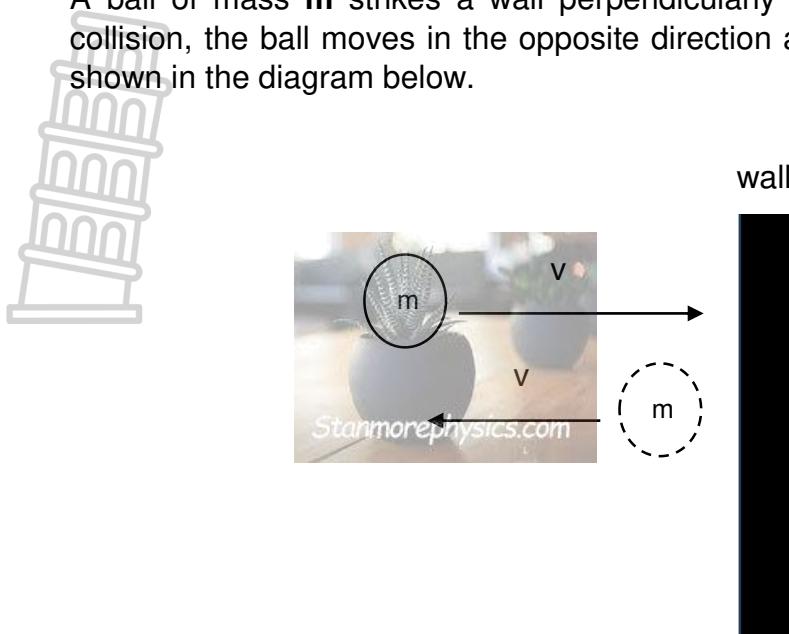


Which ONE of the following represents the magnitude of the change in momentum of the ball?

A 0

B mv

C 2mv

D $2mv^2$ (2)

1.5 The kinetic energy of a car moving at a constant velocity of 2**v** is **K**. The velocity of the car then changes to a constant velocity of 4**v**.

Which ONE of the following represents the kinetic energy of the car at a constant velocity of 4**v**?

A ⅛**K**

B ¼**K**

C 4**K**

D 8**K** (2)

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1.6 The siren of a police car travelling at 20 m·s⁻¹ emits sound waves of frequency **f** Hz.

The frequency observed by a pedestrian standing on the road when the police car moves towards him, will be …

A 0 Hz.

B smaller than **f** Hz.

C equal to **f** Hz.

D greater than **f** Hz. (2)

1.7 The diagram below represents a positive point charge.

Points **R**, **S** and **T** are at different distances from the charge.
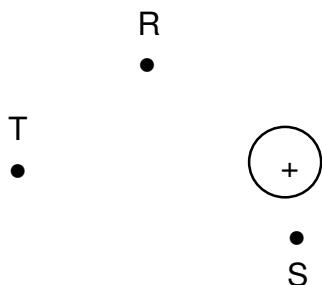


The magnitude of the electric field at a point is the …

A greatest at point **R**.

B greatest at point **S**.

C greatest at point **T**.

D same at point **R**, **S** and **T**. (2)

1.8      In the circuit represented below, the resistance of a variable resistor is INCREASED.
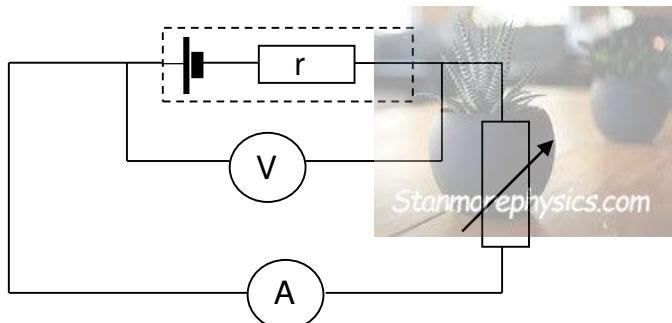


How would this increase affect the readings on the voltmeter and ammeter?

|   | VOLTMETER READING | AMMETER READING |
|---|---|---|
| A | Increases | Decreases |
| B | Decreases | Increases |
| C | Increases | Increases |
| D | Decreases | Decreases |

(2)

1.9      Which ONE of the energy conversions below takes place when an AC motor is in operation?

     A      Electrical energy to mechanical energy

     B      Mechanical energy to electrical energy

     C      Kinetic energy to mechanical energy

     D      Heat energy to mechanical energy           (2)

             

1.10    When a clean metal plate is irradiated with red light of sufficient energy, photoelectrons are emitted.

The red light is now replaced with blue light of the same intensity.

This change will …

A        increase the number of photoelectrons emitted per second.

B        decrease the number of photoelectrons emitted per second.

C        increase the kinetic energy of the emitted photoelectrons.

D        decrease the kinetic energy of the emitted photoelectrons.            (2)
                                                                                                                  **[20]**

**QUESTION 2  (Start on a new page.)**

Two blocks of masses 9 kg and 4 kg are connected by a light, inextensible string. A constant force, **F**, acting at 75° to the horizontal, is applied to the 9 kg block as shown in the diagram below. The string runs over a frictionless pulley.
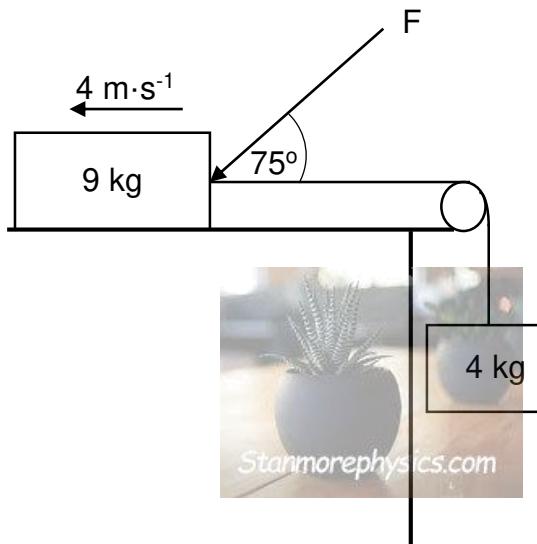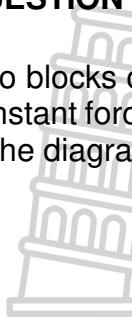


The 9 kg block moves at a CONSTANT velocity of 4 m·s⁻¹ while experiencing a frictional force of 2,5 N.

2.1    State Newton's First Law of Motion in words.                                    (2)

2.2    Draw a labelled free-body diagram for the 9 kg block.                           (5)

2.3    Calculate the magnitude of the force **F** acting on the 9 kg block.            (5)

**[12]**

**QUESTION 3  (Start on a new page.)**

Object **A** is projected vertically upwards from the ground. It takes 0,8 s to pass a window which is 1,5 m high and 8 m above the ground. It strikes a balcony at a velocity of 1,4 m·s⁻¹ and falls back to the ground.

At the same time, object **B** is projected vertically downwards at a velocity of 8 m·s⁻¹.

Ignore the effects of air friction.
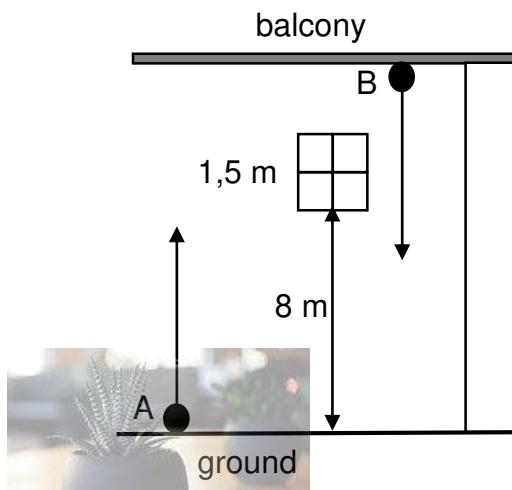


3.1    Define the term *projectile*.                                            (2)

3.2    Calculate the:

3.2.1    Velocity of object **A** at the bottom edge of the window when moving
          upwards                                                               (4)

3.2.2    Velocity with which object **A** is projected from the ground          (3)

3.2.3    Height above the ground at which object **A** and **B** will pass each
          other                                                                 (6)

3.3    Draw a position-time graph (not to scale) for the entire motion of objects **A**
        and **B** on the same set of axes from the moment they are projected.

        Label the graphs and clearly indicate the following:

        •  Height where the objects pass each other
        •  Time the objects pass each other as t                                (4)

                                                                                **[19]**

**QUESTION 4  (Start on a new page.)**

A toy trolley of mass 95 g is moving east at a speed of 2,45 m·s⁻¹. It collides with a stationary wooden block of mass 120 g, which is suspended with a rope, as shown in the diagram below.

The impact causes the block to move to a maximum height of 0,15 m from its original position, while the trolley continues moving eastwards.

Ignore the effects of friction and air friction.
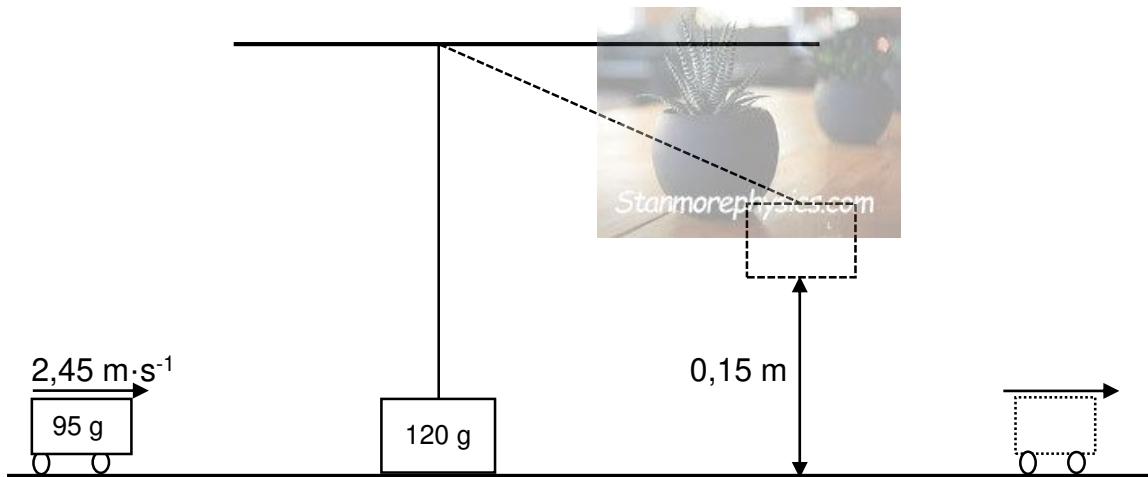


4.1     State the principle of conservation of linear momentum in words.          (2)

4.2     Draw a force diagram for the block at a height of 0,15 m above the ground.     (2)

4.3     Calculate the speed of the trolley immediately after the collision.          (5)

4.4     The contact time between the trolley and the block is 0,08 s.

        Calculate the magnitude of the force applied on the trolley by the block.     (3)

                                                                                   **[12]**

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## QUESTION 5  (Start on a new page.)

A skier of mass 100 kg starts from rest at point **B**, which is 30 m below point **A**, and moves down a frictionless curve to point **C**.

The skier passes point **C** and moves up a rough plane inclined at 30° to the horizontal. Ignore the effects of air friction.
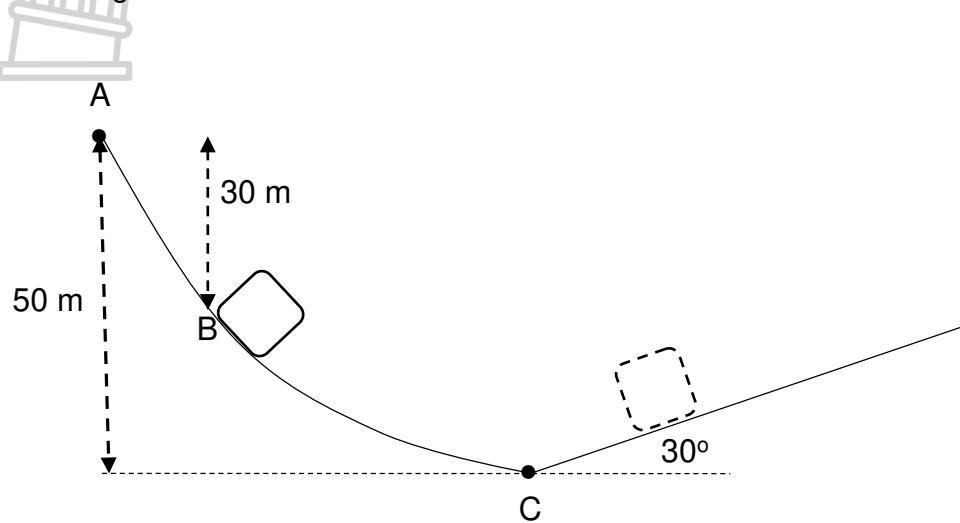


5.1 Write down the energy conversion of the skier from point **B** to **C**. (1)

5.2 Define the term *isolated system.* (2)

5.3 Use ENERGY PRINCIPLES to calculate the speed of the skier at point **C**. (4)

5.4 The skier experiences a frictional force of 200 N on the inclined plane.

5.4.1 Calculate the maximum height reached by the skier from point **C**. (6)

5.4.2 If the angle is reduced to 20˚, will the maximum height be GREATER THAN, SMALLER THAN or EQUAL TO the maximum height calculated in QUESTION 5.4.1?

Give a reason for the answer. (2)

**[15]**

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**QUESTION 6  (Start on a new page.)**

A man is sitting in a train which is travelling at a constant velocity. The siren of the train emits sound waves of frequency 2 000 Hz.

A detector placed on the railway line records a frequency of 2 450 Hz. The train takes 0,5 s to reach the detector. Assume the speed of sound in air is 342 m·s⁻¹.

6.1    Define the phenomenon described above.    (2)

6.2    Name any medical instrument that makes use of the phenomenon in QUESTION 6.1.    (1)

6.3    Calculate the distance between the train and the detector.    (5)

6.4    Draw a frequency versus time graph (not to scale) of the frequency heard by the man sitting in the train as it moves towards and away from the detector.

Indicate the values of frequency and time on the graph.    (2)

6.5    What is the significance of red shift?    (1)

**[11]**

**QUESTION 7  (Start on a new page.)**

Three charged spheres, **A**, **B** and **C,** with charges of -6 nC, +9 nC and +12 nC respectively, are placed on rubber stands as shown below.
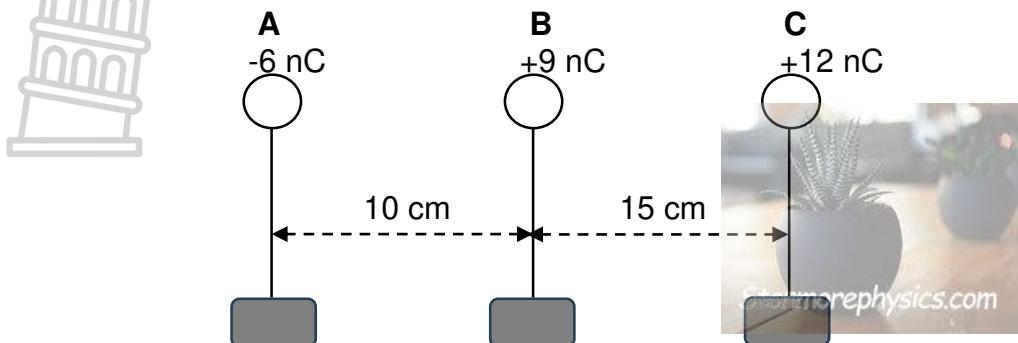


7.1     Can metal stands be used instead of rubber stands?

Write down only YES or NO.

Give a reason for the answer. (2)

7.2     State Coulomb's law in words. (2)

7.3     Calculate the net force acting on charge **C**. (5)

7.4     Charge **A** and **B** are brought into contact and then separated.

Charge **A** is returned to its original position, while charge **B** is removed.

7.4.1     In which direction did electrons flow?

Choose from **A to B** or **B to A**. (2)

7.4.2     Calculate the number of electrons transferred to or from charge **A**. (4)

7.4.3     Point **X** is placed between charge **A** and **C**.

Calculate the distance between charge **A** and point **X** where the net electric field is equal to zero. (4)

**[19]**

Please turn over

**QUESTION 8  (Start on a new page.)**

A battery of emf 12 V and an internal resistance of 0,8 Ω is connected to three resistors of resistance **R** Ω, 6 Ω and 4 Ω. A high resistance voltmeter and an ammeter of negligible resistance are also connected in the circuit, as shown below.

The reading on the ammeter is 0,5 A.
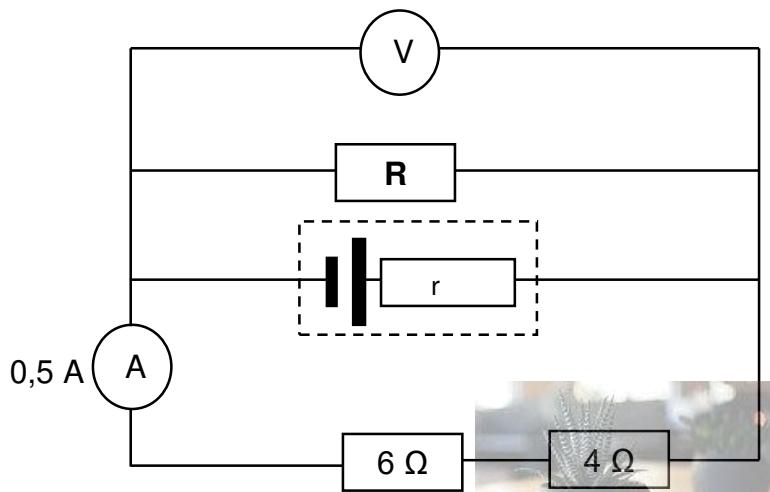


8.1     Define the term *internal resistance*.                                                    (2)

8.2     Calculate the:

8.2.1     Reading on the voltmeter                                                    (3)

8.2.2     Resistance of resistor **R**                                                    (6)

8.2.3     Energy dissipated by resistor **R** in 3 minutes                   (4)

8.3     How would the reading on the voltmeter change if resistor **R** is removed?

        Write down INCREASES, DECREASES or REMAINS THE SAME.

        Explain the answer.                                                                        (3)
                                                                                                          **[17]**

**QUESTION 9  (Start on a new page.)**

A simplified diagram of an electric machine is shown below.
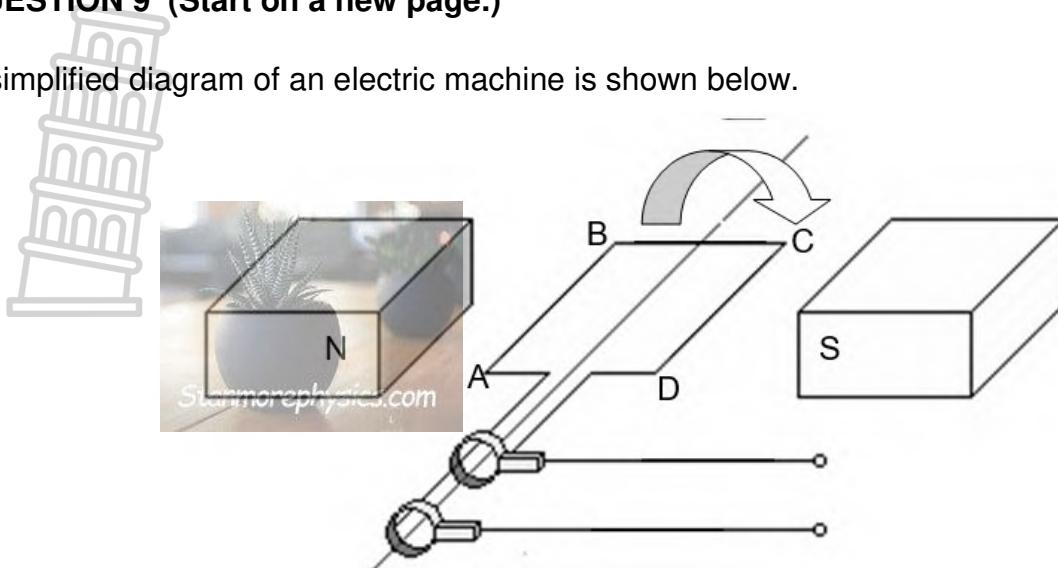


9.1     Is this electric machine a generator or an electric motor?

Give a reason for the answer.                                                        (2)

9.2     Write down the names of the components labelled **A**, **B**, **C** and **D**.     (1)

9.3     Give a reason why carbon is preferred over iron for the brushes in electric
machines.                                                                            (1)

9.4     In which direction is the current flowing?

Choose from **A to B** or **B to A**.                                                (2)

9.5     The graph below of voltage vs time was obtained from an alternating current
generator.
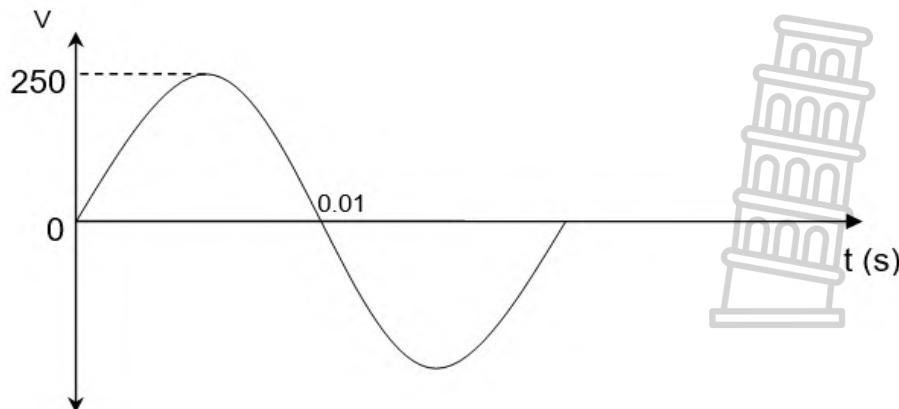


9.5.1     Calculate the frequency of this voltage.                                   (2)

9.5.2     Calculate the average power generated if the generator produces
a maximum current of 2 A.                                                            (5)

**[13]**

Please turn over

**QUESTION 10  (Start on a new page.)**

10.1    The table below shows different metals with their respective threshold frequencies.

| Metal | Threshold frequency (Hz) |
|-------|--------------------------|
| A | $2,06 \times 10^{14}$ |
| B | $1,18 \times 10^{14}$ |
| C | $0,06 \times 10^{14}$ |
| D | $8,52 \times 10^{14}$ |

Light of frequency $3,15 \times 10^{14}$ Hz is radiated on each metal.

10.1.1    Define the term *threshold frequency*.                                    (2)

10.1.2    In which metal(s), **A**, **B**, **C** or **D**, will the photoelectric effect not take place?

Give a reason for the answer.                                    (2)

10.1.3    Calculate the highest maximum speed of the ejected electrons.    (5)

10.1.4    If the intensity of light radiated is decreased, what will happen to the speed of the electrons calculated in QUESTION 10.1.3?

Choose from  INCREASES,  DECREASES  or  REMAINS THE SAME.                                    (1)

10.2    Explain the formation of the atomic emission spectrum.        (2)

**[12]**

**TOTAL:   150**

# DATA FOR PHYSICAL SCIENCES GRADE 12
# PAPER 1 (PHYSICS)

## *GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 12*
## *VRAESTEL 1 (FISIKA)*

**TABLE 1: PHYSICAL CONSTANTS/*TABEL 1: FISIESE KONSTANTES***

| NAME/*NAAM* | SYMBOL/*SIMBOOL* | VALUE/*WAARDE* |
|---|---|---|
| Acceleration due to gravity *Swaartekragversnelling* | g | $9{,}8 \text{ m·s}^{-2}$ |
| Universal gravitational constant *Universele gravitasiekonstante* | G | $6{,}67 \times 10^{-11} \text{ N·m}^2\text{·kg}^{-2}$ |
| Radius of the Earth *Radius van die Aarde* | $R_E$ | $6{,}38 \times 10^6 \text{ m}$ |
| Mass of the Earth *Massa van die Aarde* | M | $5{,}98 \times 10^{24} \text{ kg}$ |
| Speed of light in a vacuum *Spoed van lig in 'n vakuum* | c | $3{,}0 \times 10^8 \text{ m·s}^{-1}$ |
| Planck's constant *Planck se konstante* | h | $6{,}63 \times 10^{-34} \text{ J·s}$ |
| Coulomb's constant *Coulomb se konstante* | k | $9{,}0 \times 10^9 \text{ N·m}^2\text{·C}^{-2}$ |
| Charge on electron *Lading op elektron* | $e^-$ | $-1{,}6 \times 10^{-19} \text{ C}$ |
| Electron mass *Elektronmassa* | $m_e$ | $9{,}11 \times 10^{-31} \text{ kg}$ |

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## TABLE 2:  FORMULAE/*TABEL 2:  FORMULES*

### MOTION/*BEWEGING*

| | |
|---|---|
| $v_f = v_i + a\Delta t$ | $\Delta x = v_i \Delta t + \frac{1}{2}a\Delta t^2$  or  $\Delta y = v_i \Delta t + \frac{1}{2}a\Delta t^2$ |
| $v_f^2 = v_i^2 + 2a\Delta x$  or  $v_f^2 = v_i^2 + 2a\Delta y$ | $\Delta x = \left(\dfrac{v_f + v_i}{2}\right)\Delta t$  or  $\Delta y = \left(\dfrac{v_f + v_i}{2}\right)\Delta t$ |

### FORCE/*KRAG*

| | |
|---|---|
| $F_{net} = ma$ | $p = mv$ |
| $f_s^{max} = \mu_s N$ | $f_k = \mu_k N$ |
| $F_{net}\Delta t = \Delta p$ <br> $\Delta p = mv_f - mv_i$ | $w = mg$ |
| $F = G\dfrac{m_1 m_2}{d^2}$    or/*of*    $F = G\dfrac{m_1 m_2}{r^2}$ | $g = G\dfrac{M}{d^2}$    or/*of*    $g = G\dfrac{M}{r^2}$ |

### WORK, ENERGY AND POWER/*ARBEID, ENERGIE EN DRYWING*

| | |
|---|---|
| $W = F\Delta x \cos\theta$ | $U = mgh$    or/*of*    $E_P = mgh$ |
| $K = \dfrac{1}{2}mv^2$    or/*of*    $E_k = \dfrac{1}{2}mv^2$ | $W_{net} = \Delta K$    or/*of*    $W_{net} = \Delta E_k$ <br><br> $\Delta K = K_f - K_i$    or/*of*    $\Delta E_k = E_{kf} - E_{ki}$ |
| $W_{nc} = \Delta K + \Delta U$  or  $W_{nc} = \Delta E_k + \Delta E_p$ | $P = \dfrac{W}{\Delta t}$ |
| $P_{ave} = Fv_{ave}$    /    $P_{gemid} = Fv_{gemid}$ | |

### WAVES, SOUND AND LIGHT/*GOLWE, KLANK EN LIG*

| | |
|---|---|
| $v = f\lambda$ | $T = \dfrac{1}{f}$ |
| $f_L = \dfrac{v \pm v_L}{v \pm v_s}f_s$        $f_L = \dfrac{v \pm v_L}{v \pm v_b}f_b$ | $E = hf$    or    $E = h\dfrac{c}{\lambda}$ |
| $E = W_o + E_{k(max)}$  or/*of*  $E = W_o + K_{max}$  where/*waar* <br><br> $E = hf$  and/*en* $W_0 = hf_0$  and/*en* $E_{k(max)} = \dfrac{1}{2}mv_{max}^2$  or/*of*  $K_{max} = \dfrac{1}{2}mv_{max}^2$ | |

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## ELECTROSTATICS/*ELEKTROSTATIKA*

| | |
|---|---|
| $F = \dfrac{kQ_1Q_2}{r^2}$ | $E = \dfrac{kQ}{r^2}$ |
| $V = \dfrac{W}{q}$ | $E = \dfrac{F}{q}$ |
| $n = \dfrac{Q}{e}$ or/*of* $n = \dfrac{Q}{q_e}$ | |

## ELECTRIC CIRCUITS/*ELEKTRIESE STROOMBANE*

| | |
|---|---|
| $R = \dfrac{V}{I}$ | emf $(\varepsilon) = I(R + r)$ |
| $R_s = R_1 + R_2 + ...$ <br><br> $\dfrac{1}{R_p} = \dfrac{1}{R_1} + \dfrac{1}{R_2} + ...$ | $q = I\,\Delta t$ |
| $W = Vq$ <br><br> $W = VI\Delta t$ <br><br> $W = I^2R\Delta t$ <br><br> $W = \dfrac{V^2\Delta t}{R}$ | $P = \dfrac{W}{\Delta t}$ <br><br> $P = VI$ <br><br> $P = I^2R$ <br><br> $P = \dfrac{V^2}{R}$ |

## ALTERNATING CURRENT/*WISSELSTROOM*

| | |
|---|---|
| $I_{rms} = \dfrac{I_{max}}{\sqrt{2}}$ / $I_{wgk} = \dfrac{I_{maks}}{\sqrt{2}}$ <br><br> $V_{rms} = \dfrac{V_{max}}{\sqrt{2}}$ / $V_{wgk} = \dfrac{V_{maks}}{\sqrt{2}}$ | $P_{ave} = V_{rms}I_{rms}$ / $P_{gemid} = V_{wgk}I_{wgk}$ <br><br> $P_{ave} = I_{rms}^2R$ / $P_{gemid} = I_{wgk}^2R$ <br><br> $P_{ave} = \dfrac{V_{rms}^2}{R}$ / $P_{gemid} = \dfrac{V_{wgk}^2}{R}$ |

_____
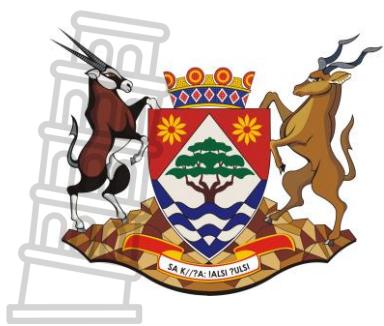
DEPARTMENT OF EDUCATION
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DEPARTEMENT VAN ONDERWYS
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LEFAPHA LA THUTO
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ISEBE LEZEMFUNDO
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**PROVINCIAL PREPARATORY EXAMINATION/**
***PROVINSIALE VOORBEREIDENDE EKSAMEN***

**GRADE/*GRAAD 12***

**PHYSICAL SCIENCES: PHYSICS**
***FISIESE WETENSKAPPE: FISIKA***

**PAPER/*VRAESTEL* 1**

**SEPTEMBER 2024**

**MARKING GUIDELINES/*NASIENRIGLYNE***

**MARKS/*PUNTE*: 150**

**These marking guidelines consist of 17 pages./**
***Hierdie nasienriglyne bestaan uit 17 bladsye.***

**QUESTION 1/*VRAAG 1***

1.1     D ✓✓                                                                              (2)

1.2     B ✓✓                                                                              (2)

1.3     B ✓✓                                                                              (2)

1.4     C ✓✓                                                                              (2)

1.5     C ✓✓                                                                              (2)

1.6     D ✓✓                                                                              (2)

1.7     B ✓✓                                                                              (2)

1.8     A ✓✓                                                                              (2)

1.9     A ✓✓                                                                              (2)

1.10    C ✓✓                                                                              (2)
                                                                                          **[20]**

## QUESTION 2/*VRAAG 2*

2.1

| **Marking criteria**/***Nasienkriteria*** |
| --- |
| If any of the underlined key words/phrases in the **correct context** is omitted, deduct one mark./*Indien enige van die onderstreepte sleutel woorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.* |

An object will <u>remain in its state of rest</u> or motion at <u>constant velocity</u> unless a <u>(non-zero) resultant force/net force</u> acts on it. $\checkmark\checkmark$

*'n Voorwerp sal in sy <u>toestand van rus</u> of beweging teen <u>konstante snelheid</u> bly, tensy 'n <u>(nie-nul) resulterende krag/netto krag</u> daarop inwerk.* $\checkmark\checkmark$

(2)

2.2
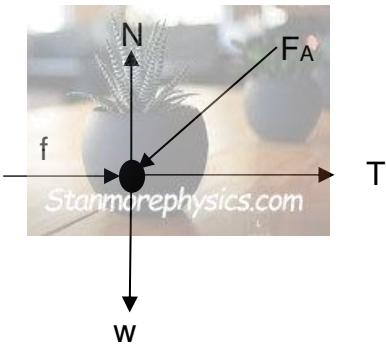


OR
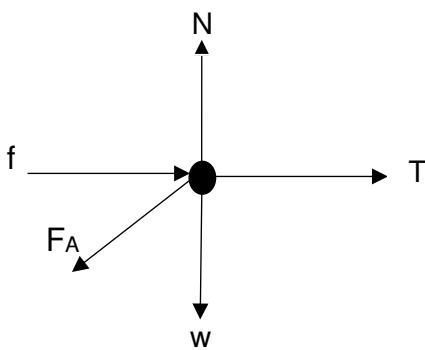


**Force diagram 0/2.**/***Kragte diagram 0/2.***

| **Accepted labels**/***Aanvaarde benoemings*** | |
| --- | --- |
| w | $F_w$ /Fg/mg/88,2 N/Weight/gravitational force<br>*$F_w$ /Fg/mg/88,2 N/Gewig/gravitasiekrag* |
| T | $F_T$ /Tension/*Spanning* |
| $F_{applied}$ | F /Applied force/$F_A$<br>*F /Toegepaste krag/$F_A$* |
| f | $F_f$ / $f_k$ /frictional force/kinetic frictional force<br>*$F_f$ / $f_k$ /wrywingskrag/kinetiese wrywingskrag* |
| N | $F_N$/Normal/*Normaal* |

| **Notes**/***Aantekeninge*** |
| --- |
| • Mark is awarded for label <u>and</u> arrow./*Punt word toegeken vir byskrif <u>en</u> pyltjie.*<br>• Do not penalise for length of arrows/*Moenie vir die lengte van die pyltjies penaliseer nie.*<br>• If arrows do not touch the dot/*Indien pyle nie die kolletjie raak nie:* Max/*Maks* $4/5$<br>• Any other additional force(s)/*Enige ander addisionele krag(te)* : Max/*Maks*: $4/5$<br>• If everything correct, but no arrows/*Indien alles korrek, maar geen pyltjies* Max/*Maks:* $4/5$ |

(5)

2.3

| **EAST AS POSITIVE** <br> *OOS AS POSITIEF* | **EAST AS NEGATIVE** <br> *OOS AS NEGATIEF* |
|---|---|
| <u>4 kg mass</u>/*4 kg massa* <br> $F_{net} = ma$ <br> $T - w = ma$ ⎫ <br> $T - mg = ma$ ⎬ ✓ (Any one) <br> <u>$T - (4)(9,8) = (4)(0)$</u> ✓ <br> $T = 39,2$ N | <u>4 kg mass</u>/*4 kg massa* <br> $F_{net} = ma$ <br> $T - w = ma$ ⎫ <br> $T - mg = ma$ ⎬ ✓ (Any one) <br> <u>$T - (4)(9,8) = (4)(0)$</u> ✓ <br> $T = 39,2$ N |
| <u>9 kg mass</u>/*9 kg massa* <br> $F_{net} = ma$ <br> $F_x + T + f = ma$ <br> <u>$-F\cos 75° + 39,2 + 2,5$</u> ✓ $= \underline{(9)(0)}$ ✓ <br> $F = 161,12$ N ✓ <br> **OR/*OF*** <br> <u>$-F\sin 15° + 39,2 + 2,5$</u> ✓ $= \underline{(9)(0)}$ ✓ <br> $F = 161,12$ N ✓ | <u>9 kg mass</u>/*9 kg massa* <br> $F_{net} = ma$ <br> $F_x + T + f = ma$ <br> <u>$F\cos 75° - 39,2 - 2,5$</u>✓ $= \underline{(9)(0)}$ ✓ <br> $F = 161,12$ N ✓ <br> **OR/*OF*** <br> <u>$F\sin 15° - 39,2 - 2,5$</u>✓ $= \underline{(9)(0)}$ ✓ <br> $F = 161,12$ N ✓ |

(5)

**[12]**

## QUESTION 3/*VRAAG 3*

**3.1**

> **Marking criteria**
> If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark./*Indien enige van die onderstreepte sleutel-woorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.*

A projectile is an object which has <u>been given an initial velocity</u> ✓and then <u>it moves under the influence of gravitational force/gravity/weight only</u>.✓

*'n Projektiel is 'n voorwerp wat 'n beginsnelheid snelheid gegee is* ✓ *en dan beweeg dit slegs onder die invloed van gravitasiekrag/swaartekrag/gewig.* ✓ (2)

**3.2.1**

| UPWARDS AS POSITIVE<br>*OPWAARTS POSITIEF* | DOWNWARDS AS POSITIVE<br>*AFWAARTS POSITIEF* |
|---|---|
| $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$✓<br>$1,5$ ✓ $= v_i(0,8) + \frac{1}{2}(-9,8)(0,8)^2$✓<br>$v_i = 5,80\,m.s^{-1}$ upwards /*opwaarts*✓ | $\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$✓<br>$-1,5$ ✓ $= -v_i(0,8) + \frac{1}{2}(9,8)(0,8)^2$✓<br>$v_i = 5,80\,m.s^{-1}$ upwards /*opwaarts*✓ |
(4)

**3.2.2** **POSITIVE MARKING FROM QUESTION 3.2.1**
*POSITIEWE NASIEN VANAF VRAAG 3.2.1*

| OPTION 1/*OPSIE 1*<br>UPWARDS AS POSITIVE<br>*OPWAARTS POSITIEF* | DOWNWARDS AS POSITIVE<br>*AFWAARTS POSITIEF* |
|---|---|
| $v_f^2 = v_i^2 + 2a\Delta y$✓<br>$(5,80)^2 = (v_i)^2 + 2(-9,8)(8)$✓<br>$v_i = 13,80\,m.s^{-1}$ upwards/*opwaarts*✓ | $v_f^2 = v_i^2 + 2a\Delta y$ ✓<br>$-(5,80)^2 = -(v_i)^2 + 2(9,8)8$✓<br>$v_i = 13,80\,m.s^{-1}$ upwards/*opwaarts*✓ |

OPTION 2/*OPSIE 2*
$\frac{1}{2}mv_i^2 + mgh_i = \frac{1}{2}mv_f^2 + mgh_f$ ✓
$\frac{1}{2}mv_i^2 + 0 = \frac{1}{2}m(5,80)^2 + m(9,8)(8)$✓
$v_i = 13,80\,m.s^{-1}$upwards/*opwaarts* ✓ (3)

**3.2.3** **POSITIVE MARKING FROM QUESTION 3.2.2**
*POSITIEWE NASIEN VANAF VRAAG 3.2.2*

$v_f^2 = v_i^2 + 2a\Delta y$
$1,4^2 = 13,8^2 + 2(-9,8)\Delta y$✓
$\Delta y = 9,62\,m$

**OR/*OF***
$\frac{1}{2}mv_i^2 + mgh_i = \frac{1}{2}mv_f^2 + mgh_f$
$\frac{1}{2}m(13,8)^2 + 0 = \frac{1}{2}m(1,4)^2 + m(9,8)(\Delta y)$ ✓
$\Delta y = 9,62\,m$

$\Delta y = v_i\Delta t + \frac{1}{2}a\Delta t^2$✓
$\Delta y = 13,8\Delta t + \frac{1}{2}(-9,8)\Delta t^2$✓ ……………(1)
$9,62 - \Delta y = 8\Delta t + 4,9\Delta t^2$✓ ……………(2)
$\Delta t = 0,44\,s$

$\Delta y = (13,8)(0,44) - (4,9)(0.44)^2$✓
$\Delta y = 5,12\,m$ ✓ (6)

3.3

**POSITIVE MARKING FROM QUESTION 3.2.3**
***POSITIEWE NASIEN VANAF VRAAG 3.2.3***
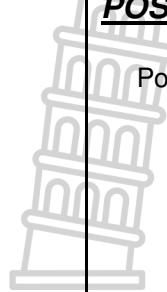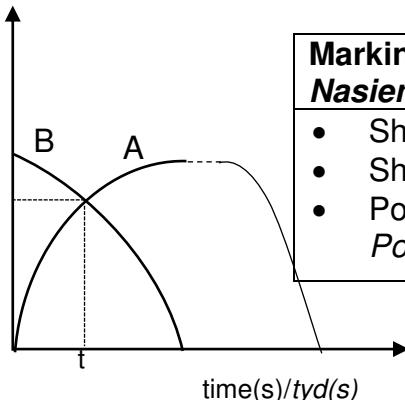


**Marking guidelines**
***Nasienriglyne***

- Shape of A/*Vorm van A*✓✓
- Shape of B/*Vorm van B*✓
- Position of t and 5,21/ *Posisie van t en* 5,21✓

(4)

**[19]**

## QUESTION 4/*VRAAG 4*

4.1

**Marking criteria/*Nasienkriteria***
If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark/*Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.*

In an <u>isolated/closed</u> system the <u>total</u> (linear) <u>momentum</u> is <u>conserved/remains constant</u>. ✓✓

*In 'n <u>geïsoleerde/geslote sisteem</u> bly die <u>totale</u> (lineêre) <u>momentum</u> <u>behoue/konstant.</u>* ✓✓

(2)

4.2
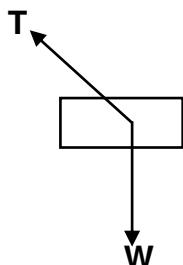


**If there is free-body diagram 0/2.**/*As ñ vrye liggaam diagram get eken word 0/2*

| **Accepted labels/*Aanvaarde benoemings*** | |
|---|---|
| **w** | $F_w$ /$F_g$ /mg /gravitational force *$F_w$ /$F_g$ /mg/gravitasiekrag* |
| **T** | $F_T$/Tension *$F_T$/spanning* |
| **Notes/*Aantekeninge*** | |

- Mark awarded for label <u>and</u> arrow./*Punt word toegeken vir byskrif <u>en</u> pyltjie.*
- Do not penalise for length of arrows./*Moenie vir die lengte van die pyltjies penaliseer nie.*

(2)

- Any other additional force(s)/*Enige ander addisionele krag(te)*: Max/*Maks* ½
- If everything is correct, but no arrows /*Indien alles korrek, maar geen pyltjies* Max/*Maks* ½
- If force(s) do not make contact with the dot:/*Indien krag(te) nie die kolletjie raak nie* Max/*Maks* ½
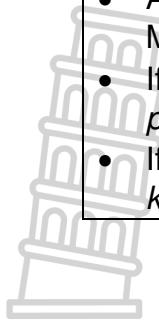
4.3

$v_f^2 = v_i^2 + 2a\Delta y$
$0^2 = v_i^2 + 2(-9,8)(0,15)$ ✓
$v_i = 1,71$ m·s$^{-1}$

**OR/OF**

$(E_k + E_p)_i = (E_k + E_p)_f$
$\frac{1}{2} m v_i^2 + mgh_i = \frac{1}{2} m v_f^2 + mgh_f$
$(\frac{1}{2})(0,12)(v_i^2) + 0 = 0 + (0,12)(9,8)(0,15)$✓
$v_i = 1,71$ m.s$^{-1}$

**OR/OF**
$W_{net} = \frac{1}{2} m v_f^2 - \frac{1}{2} m v_i^2$
$(0,12)(9,8)(0,15)(\cos180) = 0 - (\frac{1}{2})(0,12)(v_i^2)$ ✓
$v_i = 1,71$ m.s$^{-1}$

**OR/OF**
$W_{nc} = mgh_f - mgh_i + \frac{1}{2} m v_f^2 - \frac{1}{2} m v_i^2$
$0 = (0,12)(9,8)(0,15) - 0 + 0 - (\frac{1}{2})(0,12)(v_i^2)$ ✓
$v_i = 1,71$ m.s$^{-1}$

**OPTION 1/OPSIE 1**
**EAST/RIGHT AS POSITIVE/OOS/REGS AS POSITIEF**
$\Sigma p_i = \Sigma p_f$      } ✓Any one/Enige een
$m_1v_i + m_2v_i = m_1v_f + m_2v_f$ }
$(0,095)(2,45) + (0,12)(0)$ ✓ $= (0,095)(v_f) + (0,12)(1,71)$✓
$v_f = 0,29$ m·s$^{-1}$✓

**WEST/LEFT AS POSITIVE/WES/LINKS AS POSITIEF**
$\Sigma p_i = \Sigma p_f$      } ✓Any one /Enige een
$m_1v_i + m_2v_i = (m_1 + m_2)v_f$ }
$(0,095)(-2,45) + (0,12)(0)$ ✓ $= (0,095)(v_f) + (0,12)(-1,71)$ ✓
$v_f = -0,29$ m·s$^{-1}$
$v_f = 0,29$ m·s$^{-1}$✓
Range (0,28 m·s$^{-1}$ - 0,29 m·s$^{-1}$)

**OPTION 2/OPSIE 2**
**EAST/RIGHT AS POSITIVE/OOS/REGS AS POSITIEF**
$\Delta p_x = -\Delta p_y$      } ✓Any one/Enige een
$m(v_{xf} - v_{xi}) = - m(v_{yf} - v_{yi})$ }
$0,095(v_f - 2,45)$ ✓ $= -0,12(1,71 - 0)$ ✓
$v_f = 0,29$ m·s$^{-1}$✓

**WEST/LEFT AS POSITIVE/WES/LINKS AS POSITIEF**
$\Delta p_x = -\Delta p_y$
$m(v_{xf} - v_{xi}) = - m(v_{yf} - v_{yi})$      } ✓Any one/Enige een
$0,095(v_f + 2,45)$ ✓ $= -0,12(-1,71 - 0)$ ✓
$v_f = -0,29$ m·s$^{-1}$
$v_f = 0,29$ m·s$^{-1}$✓

(5)

4.4    **POSITIVE MARKING FROM QUESTION 4.3**
       ***POSITIEWE NASIEN VANAF VRAAG 4.3***

**OPTION 1/*OPSIE 1***

**EAST AS POSITIVE/*OOS AS POSITIEF***

$F_{net}\Delta t = \Delta p$ ⎤ ✓Any one/*Enige een*
$F_{net}\Delta t = m(v_f - v_i)$ ⎦

$\underline{F_{net}(0,08) = 0,095(0,29 - 2,45)}$ ✓ **OR/*OF*** $\underline{F_{net}(0,08) = 0,012(1,71 - 0)}$ ✓

$F_{net} = -2,565$ N                          $F_{net} = 2,57$ N✓

$F_{net} = 2,57$ N✓

**WEST AS POSITIVE/*WES AS POSITIEF***

$F_{net}\Delta t = \Delta p$ ⎤ ✓Any one/*Enige een*
$F_{net}\Delta t = m(v_f - v_i)$ ⎦

$\underline{F_{net}(0,08) = 0,095(-0,29 + 2,45)}$✓**OR/*OF*** $\underline{F_{net}(0,08) = 0,12(-1,71 - 0)}$ ✓

$F_{net} = 2,57$ N✓                          $F_{net} = 2,57$

                                             $F_{net} = 2,57$ N✓

| **OPTION 2/*OPSIE 2*** | |
| --- | --- |
| **EAST AS POSITIVE** ***OOS AS POSITIEF*** | **WEST AS POSITIVE** ***WES AS POSITIEF*** |
| $v_f = v_i + a\Delta t$ | $v_f = v_i + a\Delta t$ |
| $0,29 = 2,45 + a(0,08)$ ✓ | $-0,29 = -2,45 + a(0,08)$ ✓ |
| $a = -27$ m·s⁻² | $a = 27$ m·s⁻² |
| $F_{net} = ma$✓ | $F_{net} = ma$✓ |
| $= 0,095\,(-27)$ | $= 0,095\,(27)$ |
| $= -2,565$ N | $= 2,57$ N✓ |
| $= 2,57$ N | |

(3)

**[12]**

## QUESTION 5/*VRAAG 5*

5.1    Potential energy to kinetic energy/*Potensiële energie na kinetiese
energie*✓                                                                 (1)

5.2

| **Marking criteria/*Nasienkriteria*** |
| --- |
| If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark/*Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.* |

A system in which the net external forces acting on the system is zero.✓✓
*'n Sisteem waarin die netto eksterne kragte wat op die sisteem inwerk nul
is*                                                                       (2)

5.3

| **OPTION 1/*OPSIE 1*** |
| --- |
| $\frac{1}{2} m v^2_i + mgh_i = \frac{1}{2} m v^2_f + mgh_f$✓ |
| $\underline{(100)(9,8)(20)} + 0$ ✓ $= 0 + \underline{(\frac{1}{2})(100)(v_f^2)}$ ✓ |
| $v_f = 19,80$ m.s$^{-1}$✓ |

| **OPTION 2/*OPSIE 2*** |
| --- |
| $W_{net} = \frac{1}{2} m v^2_f - \frac{1}{2} m v^2_i$✓ |
| $\underline{(100)(20)(9,8)(cos0)}$✓ $= \underline{(\frac{1}{2})(100)(v_f^2)}$ ✓ $- 0$ |
| $v_f = 19,80$ m.s$^{-1}$✓ |

| **OPTION 3/*OPSIE 3*** |
| --- |
| $W_{nc} = mgh_f - mgh_i + \frac{1}{2} m v^2_f - \frac{1}{2} m v^2_i$✓ |
| $\underline{0}$✓ $= 0 - \underline{(100)(9,8)(20) + \frac{1}{2}(100) v^2_f} - 0$✓ |
| $v_f = 19,80$ m.s$^{-1}$✓ |

(4)

5.4.1    **POSITIVE MARKING FROM QUESTION 5.3**
***POSITIEWE NASIEN VANAF VRAAG 5.3***

| **OPTION 1/*OPSIE 1*** |
| --- |
| $W_{net} = \Delta E_k$ ✓ |
| $W_{net} = \underline{(\frac{1}{2})(100)(0)^2 - (\frac{1}{2})(100)(19,80)^2}$✓ |
| $W_{net} = -19\ 602$ J |
| $W_{net} = W_G + W_f$ |
| $\underline{-19\ 602}$✓ $= (100)(9,8)(sin30º)(\Delta x)(cos180º) + (200)(\Delta x)(cos180º)$✓ |
| $\Delta x = 28,41$ m |
| $h = (28,41)(sin30º)$✓ |
| $h = 14,21$ m✓ |

| **OPTION 2/*OPSIE 2*** |
| --- |
| $W_{nc} = \Delta E_p + \Delta E_k$ ✓Any one/*Enige een* |
| $W_{nc} = mgh_f - mgh_i + \frac{1}{2} m v^2_f - \frac{1}{2} m v^2_i$ |
| $(200)\left(\frac{h}{sin30º}\right)$✓$cos180º$✓ $= (100)(9,8)(h) - 0$✓ $+ 0 - \frac{1}{2}(100)(19,80)^2$✓ |
| $h = 14,20$ m✓ |

| **OPTION 3**/**OPSIE 3** |
| --- |
| $F_{net}$ = ma ✓ |
| -(100)(9,8)(sin30°)✓ – 200 = 100a✓ |
| a = -6,9 m.s$^{-2}$ |
| |
| $v_f^2 = v_i^2 + 2a\Delta y$ |
| $0^2 = 19,80^2 + 2(-6,9)(\Delta x)$ ✓ |
| $\Delta x$ = 28,41 m |
| |
| h = (28,41)(sin30°)✓ |
| h = 14,21 m✓ |

(6)

5.4.2    Smaller than/*kleiner as* ✓
The net force acting on the object will decrease./*Die netto krag wat op die voorwerp inwerk sal verminder* ✓ (2)

**[15]**

**QUESTION 6/*VRAAG 6***

6.1
| **Marking criteria**/***Nasienkriteria*** |
| --- |
| If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark./*Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.* |

The change in frequency (or pitch) of the sound detected by a listener because the sound source and the listener have different velocities relative to the medium of sound propagation. ✓✓
*Die verandering in frekwensie (of toonhoogte) van die klank waargeneem deur 'n luisteraar omdat die klankbron en die luisteraar verskillende snelhede relatief tot die medium waarin die klank voortgeplant word, het.*

**OR/*OF***
An (apparent) change in observed/detected frequency (pitch), as a result of the relative motion between a source and an observer (listener).
*'n Skynbare verandering in waargenome frekwensie (toonhoogte), as gevolg van die relatiewe beweging tussen die bron en 'n waarnemer (luisteraar).* (2)

6.2    Doppler ultrasound machine or Doppler flow meter/*Doppler-ultraklankmasjien of Doppler-vloeimeter* (**Any one/*Enige een***). ✓ (1)

6.3

$$f_L = \frac{v \pm v_L}{v \pm v_s} f_s \quad \textbf{OR}/\textbf{OF} \quad f_L = \frac{v}{v - v_s} f_s \checkmark$$

$$2\,450 \checkmark = \frac{342}{342 - v_s}(2\,000) \checkmark$$

$$v_s = 62{,}82 \text{ m·s}^{-1}$$

| | |
|---|---|
| $\Delta v = \frac{\Delta x}{\Delta t}$ | $\Delta x = \left(\frac{v_i + v_f}{2}\right)\Delta t$ |
| $62{,}82 = \frac{\Delta x}{0{,}5} \checkmark$ | $\Delta x = \left(\frac{62{,}82 + 62{,}82}{2}\right)(0{,}5)$ |
| $\Delta x = 31{,}41 \text{ m} \checkmark$ | $\Delta x = 31{,}41 \text{ m}$ |

(5)

6.4

**Marking guidelines/*Nasienriglyne***
- Shape of graph/*Vorm van grafiek*✓
- 2000 Hz and/*en* 0,5 s ✓
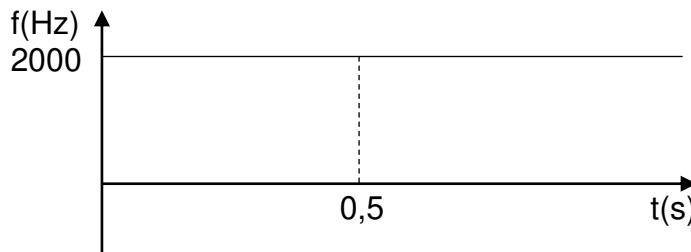


(2)

6.5    Shows that the Universe is expanding/*Toon dat die heelal besig is om uit te brei* ✓

(1)

**[11]**

**QUESTION 7/*VRAAG 7***

7.1     NO/*NEE*✓

The spheres will lose their charge./The metal stands are electrical conductors.✓/*Die sfere sal hul lading verloor./Die metaalstaanders is elektriese geleiers.*                                                                (2)

| 7.2 | **Marking criteria/*Nasienkriteria*** |
|---|---|
| | If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark *Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.* |

The (magnitude of the) <u>electrostatic force exerted by one point charge on another</u> point charge is <u>directly proportional to the product of the (magnitudes of the) charges</u> and <u>inversely proportional to the square of the distance between them.</u>✓✓/*Die (grootte van die) elektrostatiese krag wat een puntlading op 'n ander puntlading uitgeoefen, is direk eweredig aan die produk van die (groottes van die) ladings en omgekeerd eweredig aan die kwadraat van die afstand tussen hulle.*                            (2)

**If mass is used 0/2./*Indien massa gebruik word in plaas van* lading 0/2**

7.3     **OPTION 1/*OPSIE 1***

$$F = \frac{kQ_1Q_2}{r^2} \checkmark$$

$$F_{CA} = \frac{(9 \times 10^9)(12 \times 10^{-9})(6 \times 10^{-9})}{(0,25)^2} \checkmark = 1,04 \times 10^{-5} \text{ N}$$

$$F_{CB} = \frac{(9 \times 10^9)(12 \times 10^{-9})(9 \times 10^{-9})}{(0,15)^2} \checkmark = 4,32 \times 10^{-5} \text{ N}$$

$F_{net} = 4,32 \times 10^{-5}$ N - (1,04 × 10⁻⁵ N ) ✓

= 3,28×10⁻⁵ N due East/ Right/*reg/ Oos* ✓

**OPTION 2/*OPSIE 2***

$$E = \frac{kQ}{r^2} \checkmark$$

$$E_{CA} = \frac{(9 \times 10^9)(6 \times 10^{-9})}{(0,25)^2} \checkmark = 864 \text{ N·C}^{-1}$$

$$E_{CB} = \frac{(9 \times 10^9)(9 \times 10^{-9})}{(0,15)^2} \checkmark = 3\,600 \text{ N·C}^{-1}$$

$E_{net} = 3\,600 - 864 = 2\,736$ N.C⁻¹ due East

$F = EQ \checkmark$

= (2 736 × 12 × 10⁻⁹)✓

= 3,28×10⁻⁵ N due East/Right/*reg/Oos*✓

                                                                                                (5)

7.4.1     A to B /*A na B*✓✓                                                                (2)

7.4.2
$$Q = \frac{Q_1 + Q_2}{2}$$

$$= \frac{(-6 \times 10^{-9}) + (9 \times 10^{-9})}{2} \checkmark$$

$$Q = 1,5 \times 10^{-9} \text{ C}$$
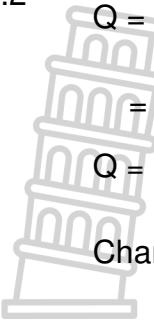
Charge transferred/*Lading oorgedra* = $1,5 \times 10^{-9}$ C – ($-6 \times 10^{-9}$ C )
$$= 7,5 \times 10^{-9} \text{ C}$$

**OR/OF**

$$= (1,5 \times 10^{-9} \text{ C} – (9 \times 10^{-9} \text{ C} )$$
$$= -7,5 \times 10^{-9} \text{ C}$$

$$n = \frac{Q}{q_e} \checkmark$$

$$n = \frac{7,5 \times 10^{-9}}{1,6 \times 10^{-19}} \checkmark$$

$$n = 4,69 \times 10^{10} \text{ (electrons/elektrone)} \checkmark \qquad (4)$$

| |
|---|
| 7.4.3 **OPTION 1/OPSIE 1** |

7.4.3

**OPTION 1/OPSIE 1**

$$E = \frac{kQ}{r^2} \checkmark$$

$$\frac{(9 \times 10^9)(1,5 \times 10^{-9})}{(b)^2} \checkmark = \frac{(9 \times 10^9)(12 \times 10^{-9})}{(0,25 - b)^2} \checkmark$$

$$b = 0,07 \text{ m} \checkmark$$

**OPTION 2/OPSIE 2**

$$F = \frac{kQ_1Q_2}{r^2} \checkmark$$

$$\frac{(9 \times 10^9)(1,5 \times 10^{-9})Q}{(b)^2} \checkmark = \frac{(9 \times 10^9)(12 \times 10^{-9})Q}{(0,25 - b)^2} \checkmark$$

$$b = 0,07 \text{ m} \checkmark \qquad (4)$$

**[19]**

## QUESTION 8/*VRAAG 8*

8.1

| **Marking criteria/Nasienkriteria** |
|---|
| If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark./*Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.* |

The <u>resistance within a battery</u> that causes a <u>drop in the potential difference</u> of the battery <u>when there is a current</u> in the circuit.$\checkmark\checkmark$ *Die <u>weerstand binne 'n battery</u> wat 'n <u>daling in die potensiaalverskil</u> van die battery veroorsaak <u>wanneer daar 'n stroom</u> in die stroombaan is.*

**Accept/Aanvaar**

Opposition to the flow of current/charges inside the battery due to its chemicals./*Werk teen die vloei van lading/stroom binne die battery as gevolg van chemikaliee* (2)

8.2.1    $V = IR$ ✓
        $= (0,5)(6 + 4)$ ✓
        $= 5 \text{ V}$ ✓                                                    (3)
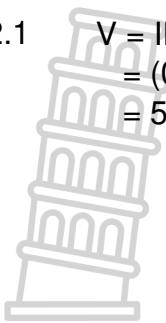
8.2.2 **POSITIVE MARKING FROM QUESTION 8.2.1**
**POSITIEWE NASIEN VANAF VRAAG 8.2.1.**

| **OPTION 1/*OPSIE 1*** |
| --- |
| $\varepsilon = I(R + r)$ ✓ |
| $12$✓ $= 5 + 0,8I$✓ |
| $I = 8,75$ A |
| |
| $V = IR$✓ |
| $5 = 8,25R$✓ |
| $R = 0,61$ Ω✓ |
| **OPTION 2/*OPSIE 2*** |
| $V = IR$✓ |
| $5$ ✓ $= I\left(\dfrac{10R}{10+R}\right)$ ✓ ………………..(1) |
| $12$ ✓ $= I\left(\dfrac{10R}{10+R} + 0,8\right)$ ✓ .…..…..(2) |
| $R = 0.61$ Ω ✓ |

(6)

8.2.3 **POSITIVE MARKING FROM QUESTION 8.2.1 AND 8.2.2**
**POSITIEWE NASIEN VANAF VRAAG 8.2.1 EN 8.2.2**

| **OPTION 1/*OPSIE 1*** | **OPTION 2/*OPSIE 2*** | **OPTION 3/*OPSIE 3*** |
| --- | --- | --- |
| $W = I^2R\Delta t$ ✓ | $W = VI\Delta t$ ✓ | $W = \dfrac{V^2\Delta t}{R}$ ✓ |
| $= (8,25)^2(0,61)(180)$✓ | $= (5)(8,25)(180)$ ✓ | |
| $= 7\ 473,26$ J✓ | $= 7\ 425$ J ✓ | $= \dfrac{(5)^2(180)}{0,61}$ ✓ |
| | | $= 7\ 377,05$ J ✓ |

(3)

8.3 Increases/*Toeneem*✓

Total external resistance will increase✓ and total current will decrease, ✓
emf remains constant and internal voltage decreases.
*Totale eksterne weerstand sal toeneem en totale stroom sal afneem, emk*
*bly konstant en interne spanning neem af.*

(3)

**[17]**

**QUESTION 9/*VRAAG 9***

9.1     Generator/*Generator*✓ ,
        It converts mechanical energy to electrical energy.✓/*Dit skakel meganiese*
        *energie om na elektriese energie.*
                     **Accept/*Aanvaar***
        There is no energy source./*Daar is geen energie bron.*                  (2)

9.2     Coil/*Spoel*/Conductor/*Geleier*/Armature/*roterende spoel*✓              (1)

9.3     Good conductor of electricity/*Goeie geleier van elektrisiteit*/Does not
        rust/*Roes nie* ✓ (**Any one/*Enige een***)                              (1)

9.4     A to/*na* B✓✓                                                             (2)

9.5.1   $f = \dfrac{1}{T}$

        $= \dfrac{1}{0,02}$ ✓

        $= 50$ Hz ✓                                                              (2)

9.5.2

| **OPTION 1/*OPSIE 1*** | **OPTION 2/*OPSIE 2*** |
|---|---|
| $V_{rms} = \dfrac{V_{max}}{\sqrt{2}}$ $= \dfrac{250}{\sqrt{2}}$ ✓ $= 176,78\ldots$ V | $V_{rms} = \dfrac{V_{max}}{\sqrt{2}}$ $= \dfrac{250}{\sqrt{2}}$ ✓ $= 176,78\ldots$ V |
| $I_{rms} = \dfrac{I_{max}}{\sqrt{2}}$ $I_{rms} = \dfrac{I_{max}}{\sqrt{2}}$ $= \dfrac{2}{\sqrt{2}}$ ✓ $= 1,41$A | $I_{rms} = \dfrac{I_{max}}{\sqrt{2}}$ $I_{rms} = \dfrac{I_{max}}{\sqrt{2}}$ $= \dfrac{2}{\sqrt{2}}$ ✓ $= 1,41$A |
| $P_{ave} = V_{rms}I_{rms}$✓ $= (176,78)(1,41)$✓ $= 249,26$ W✓ | $R = \dfrac{V_{rms}}{I_{rms}}$ $= \dfrac{176,78}{1,41}$ $= 125,38\ \Omega$ $P_{ave} = \dfrac{V_{rms}^2}{R}$ ✓ $= \dfrac{(176,78)^2}{125,38}$ ✓ $= 249,25$ W ✓ |

**OPTION 3/*OPSIE 3***

$V_{rms} = \dfrac{V_{max}}{\sqrt{2}}$

$\phantom{V_{rms}} = \dfrac{250}{\sqrt{2}}$ ✓

$\phantom{V_{rms}} = 176{,}78\ldots \text{ V}$

$I_{rms} = \dfrac{I_{max}}{\sqrt{2}}$

$I_{rms} = \dfrac{I_{max}}{\sqrt{2}}$

$\phantom{I_{rms}} = \dfrac{2}{\sqrt{2}}$ ✓

$\phantom{I_{rms}} = 1{,}41 \text{ A}$

$R = \dfrac{V_{rms}}{I_{rms}}$

$\phantom{R} = \dfrac{176{,}78}{1{,}41}$

$\phantom{R} = 125{,}38 \ \Omega$

$P_{ave} = I_{rms}^{2}R$ ✓

$\phantom{P_{ave}} = (1{,}41)^{2}(125{,}38)$ ✓

$\phantom{P_{ave}} = 249{,}27 \text{ W}$ ✓

(5)

**[13]**

Note/*Let wel:*  Range (249,25 – 250 W)

## QUESTION 10/*VRAAG 10*

10.1.1  | **Marking criteria**
If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark /*Indien enige van die onderstreepte sleutelwoorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.*
The minimum frequency needed to emit an electron ✓ from (the surface of) a metal. ✓
*Die minimum frekwensie wat nodig is om 'n elektron vanaf (die oppervlak van) 'n metaal uit te straal.*

| **NOTE: If reference to work function 0/2**
**LET WEL:  Indien verwysing na werkfunksie 0/2**                    (2)

10.1.2    D ✓
Frequency of light is less than the threshold frequency /$f < f_0$ / Energy of light is less than the work function of the metal /$E < W_0$ ✓
*Frekwensie van lig is minder as die drumpelfrekwensie /$f < f_0$ / Energie van lig is minder as die werkfunksie van die metaal /$E < W_0$* ✓                    (2)

10.1.3    $E = W_o + E_{k(max)}$
$E = W_o + K_{max}$ ⎤ ✓ (any one)
$(6,63{\times}10^{-34})(3,15{\times}10^{14})$✓ $= \underline{(6,63{\times}10^{-34})(0,06{\times}10^{14})}$✓ $+ \underline{\tfrac{1}{2}(9,11{\times}10^{-31})v^2}$✓
$v = 6,71{\times}10^5$ m·s⁻¹✓                    (5)

10.1.4    Remains the same /*Bly dieselfde* ✓                    (1)

10.2    | **Marking criteria/*Nasienkriteria***
If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark/*Indien enige van die onderstreepte sleutel woorde/frases in die **korrekte konteks** uitgelaat is, trek 1 punt af.*

It is formed when certain <u>frequencies of electromagnetic radiation are emitted</u> due to an atom making a transition from a <u>higher energy state to a lower energy state</u>./*Dit word gevorm wanneer sekere <u>frekwensies van elektromagnetiese straling uitgestraal</u> word as gevolg van 'n atoom wat 'n oorgang maak van 'n <u>hoër energietoestand na 'n laer energietoestand.</u>*                    (2)

**[12]**
**TOTAL/*TOTAAL*:   150**